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System-Wide Impacts of Hospital Payment Reforms

Evidence from Central and Eastern Europe and Central Asia

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Abstract

Although there is broad agreement that the way that health care providers are paid affects their performance, the empirical literature on the impacts of provider payment reforms is surprisingly thin. During the 1990s and early 2000s, many European and Central Asian countries shifted from paying hospitals through historical budgets to fee-for-service or patient-based-payment methods (mostly variants of diagnosis-related groups). Using panel data on 28 countries over the period 1990–2004, the authors of this study exploit the phased shift from historical budgets to explore aggregate impacts on hospital throughput, national health spending, and mortality from causes amenable to medical care. They use a regression version of difference-in-differences and two variants that relax the difference-in-differences parallel trends assumption. The results show that fee-for-service and patient-based-payment methods both increased national health spending, including private (out-of-pocket) spending. However, they had different effects on inpatient admissions (fee-for-service increased them; patient-based-payment had no effect), and average length of stay (fee-for-service had no effect; patient-based-payment reduced it). Of the two methods, only patient-based-payment appears to have had any beneficial effect on "amenable mortality," but there were significant impacts for only a couple of causes of death, and not in all model specifications.

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System-Wide Impacts of Hospital Payment Reforms: Evidence from Central and Eastern Europe and Central Asia

by

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1. Introduction

While there is broad agreement that the way that health care providers are paid affects their performance, and that payment reform ought to be an important component of any strategy to improve the efficiency of the health sector, the empirical literature on the impacts of provider payment reforms is surprisingly thin (cf. e.g. Docteur and Oxley 2003). There is a good deal of work describing changes in provider payment methods.[1] And there are studies that analyze likely impacts at a theoretical level.[2] But empirical studies of the impacts of payment method changes are relatively few. Moreover, from a policymaking perspective, the literature that does exist has at least four limitations.

The first limitation of the literature to date is that it focuses largely on one country—the United States, and in particular on the shift by Medicare in 1983 to paying hospitals through the use of diagnosis-related groups (DRGs) and subsequent adjustments to the new system.[3] There are exceptions, of course: a handful of studies have looked at the effects of shifts from fee-for-service or line-item budgets to prospective payments in the hospital sectors of other countries (notably China, Hungary, Italy, Korea, Portugal, Sweden, and Taiwan).[4] However, the fact remains that the impacts of payment reforms outside the US are largely unresearched.

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[1] For example, a special issue of the journal *Health Care Management Science* (Busse *et al.* 2006) describes the shift to case-based payment systems in European hospitals.

[2] See e.g. Ellis and McGuire (1986), Frank and Lave (1989), and Ellis (1998).

[3] Examples include Davis and Rhodes (1988), Frank and Lave (1989), Cutler (1995), and Dafny (2005).

[4] Louis *et al.* (1999) look at the effects on admissions, length of stay and hospital mortality of a shift in one region in Italy from global budgets to DRGs. Gerdtham *et al.* (1999) look at the effects on hospital efficiency of a shift among some county councils in Sweden from line-item budgets to prospective payments. Kroneman and Nagy (2001) look at the effects on hospital admissions, length of stay, and the bed-occupancy rate of a shift in Hungary from line-item budgeting to DRGs. Yip and Eggleston (2001) look at the effect on outlays by hospitals and the social health insurance fund of a shift by social

A second limitation of the literature is that the studies to date have focused mostly on the hospitals that have been the subject of the payment reform. Most studies do not attempt to capture any impacts on other actors in the health system. Again, there are exceptions: some (see e.g. Cutler (1995) and Dafny (2005)) capture the impacts not just on hospital costs and activity rates but on the health outcomes (i.e. mortality) of the patients treated by the hospitals. However, conspicuous by their absence are studies that look at the system-wide impacts of provider payment reforms. It seems inevitable that some types of payment method are more costly for a payer to operate than others. Marini and Street (2007), for example, found that the shift from block contracts to activity-based payments in the NHS in England entailed a substantial net increase in transactions costs incurred by the payer.[5] Changes in the way that hospitals are paid may also be associated with changes in the amounts that patients pay out-of-pocket; hospitals may be able to make up for lower revenues from a public payer by charging patients more. Payment reforms may also alter utilization patterns across different types of providers. In response to payment reforms, hospitals may seek to deter complex patients from seeking care from them, or they may discharge patients early. As a result, patients may end up being treated elsewhere in the system, so that utilization rates and costs outside the hospital sector may be driven up, and population health might be adversely affected. Not knowing about these broader consequences of provider payment reform seems a potentially important gap in our knowledge.

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insurers in one province in China from fee-for-service to prospective payments. Dismuke and Guimaraes (2002) look at the effects on hospital mortality of a shift in Portugal from fee-for-service to DRGs. Kwon (2003) look at the effects on hospital costs of a shift in Korea from fee-for-service to DRGs. Lang et al. (2004) look at the effect on utilization and costs of a shift in Taiwan from fee-for-service to DRGs.

[5] The higher costs are associated with volume control, data-collection (activity-based payment systems require accurate patient-level data), monitoring costs (including guarding against the equivalent of DRG creep), and enforcement of contracts.

A third limitation of studies to date is that they have often been limited in scope, or the reforms analyzed have been limited in scope. The reforms in China, Italy, and Sweden were limited to a small number of geographic areas, while the reform in Korea was just a pilot program for a limited number of hospitals. The studies in Portugal and Taiwan were limited to a small number of conditions, even though the payment reform concerned more conditions. In some studies, the reforms were limited to a small number of medical conditions or just one payer (Medicare in the US and the urban health insurance agency in China). Where the number of conditions involved is limited, or the number of payers involved is limited, it is possible that providers may engage in mitigating behavior, transferring costs to patients whose conditions are not covered by the new payment system or whose costs are paid by payers using unreformed payment mechanisms. Such studies may therefore be a poor guide to the effects of introducing payment reforms that affect all conditions and all payers.

The final limitation of studies to date is that not all have been as analytically rigorous as they might have been, varying in particular in the degree to which they control for the confounding effects of observed and unobserved influences on the outcomes studied that may also be correlated with the payment reform. Some studies compare outcomes among providers with unreformed payment systems with those with reformed payment systems, while others compare outcomes before payment reforms with outcomes after payment reforms. The risk with such studies is that even if observable factors are controlled for by means of a regression model, there may be unobservable factors that differ between the unreformed and reformed providers, or that change after the provider payment reform is introduced. More compelling are studies based on *differences* in differences, i.e. changes in outcomes between providers with unreformed payment methods and providers with reformed payment methods. These are, however, relatively few in number.[6]

The present study contributes to the empirical literature on the impacts of provider reforms, and tries to avoid the four limitations of the previous literature mentioned above. First, we examine the impacts of provider payment reforms in 28 countries, all but one of which do not feature in the literature to date. All are located in (Central and Eastern) Europe and Central Asia (ECA).[7] Many of the countries covered in the paper altered the way they pay hospitals during the 1990s, sometimes more than once, and sometimes as part of a broader provider payment reform strategy. To our knowledge, with the exception of DRG adoption in Hungary, the impacts of these reforms have not been analyzed in international journals. Second, our approach is to look at the impacts of these reforms at the level of the entire health system. Our unit of observation is not the individual hospital let alone the patient, but rather the country as a whole. Our results concerning impacts on health expenditures thus get at the effects of hospital payment reforms on health spending in the entire health system, not just expenditures incurred in the hospitals where the payment reform was implemented. Similarly, our results concerning impacts on amenable mortality get at the effects on mortality among the entire population, not just among patients admitted to hospitals whose payment methods were changed. Third, the reforms we examine are typically broad reforms that affect all hospitals, all payers (most countries have, in fact, just one payer), and a large number of conditions. Likewise our study is broad in scope; we analyze many outcomes, including hospital activity measures, health sector spending (public *and* private), and amenable mortality. Fourth, our econometric

[6] Examples are Yip and Eggleston (2001) and Dafny (2005).
[7] The countries treated as being in Central and Eastern Europe and Central Asia (the countries in the World Bank's 'ECA' region) are listed in Figure 1.

approach is a generalization of differences-in-differences (DID), which we employ on panel data covering the 28 countries over the period 1990 to 2004. Like DID, our approach eliminates the confounding effects of unobservables that remain constant over time. But unlike DID our approach relaxes the parallel trends assumption that some regard as the Achilles heel of DID.

The paper is organized as follows. Section 2 outlines the payment reforms in the ECA countries. Most went into the 1990s with a Semashko Soviet-style health system. Many shifted to a social health insurance model, and following this shift began to move away from the line-item budget method of paying hospitals. Some shifted to fee-for-service (FFS). Some moved to DRGs. Some shifted to FFS and then to DRGs. Some ended up making parallel payment reforms in the primary care sector, and some ended up imposing global budgets on hospitals. We take these parallel reforms into account in our empirical analysis. An attraction of our study is that we are able to shed light on the relative merits of all three broad approaches to paying providers (Ellis and Miller 2008): payments based on provider characteristics (line-item budgets being an example); payments based on service characteristics (FFS being an example); and payments based on patient characteristics (DRGs being an example). Section 3 sets out our hypotheses concerning the impacts of these payment method changes on the outcomes of interest, namely inpatient admissions, average length of stay, the number of beds, the bed occupancy rate, health sector spending, and amenable mortality (i.e. causes where timely and effective medical care can result in a premature death being avoided). Section 4 outlines our methods, including the tests we use to assess the validity of different models. We also outline our test of reverse causality, a concern being that DID models may not adequately account for the possibility that direction of causation runs not from payment reforms to changes in outcomes but rather vice versa. Countries that shifted payment system may have done so out of a concern over underlying health system weaknesses causing poor outcomes. Section 5 introduces our data, including our payment method classificatory variables. Inevitably there is some arbitrariness about these at the margin, so we have assessed the robustness of our results to alternative classifications. Section 6 presents our results, both of the specification tests and our estimates of payment method impacts. Section 7 contains our conclusions.

2. Provider payment reforms in the ECA countries

In almost all the former communist countries of the ECA region, the health care sector was organized exclusively along the lines of the centrally planned Semashko model during the communist era.[8] Characteristically, this meant general revenues financing in addition to out-of-pocket payments—the latter primarily taking the form of payments for drugs and "gratuities" paid by patients to providers. The state normally owned the whole network of health care providers with no participation of a private sector. Salaries were the prevalent form of paying medical doctors and other health professionals. Providers were organized in a tiered system and historical, line-item budgeting was used to reimburse hospitals; that is, budgets or block grants were allocated to hospitals according to population-based and, mainly, capacity norms (such as the number of beds, the most commonly used criterion). From year to year, the historical budget accruing to a given hospital could be adjusted by some inflation factor, yet there was rarely any reallocation across spending categories.

[8] This section draws heavily on Dixon et al. (2004) and the Health Systems in Transition (*HiT*) series, downloadable from http://www.euro.who.int/observatory/Hits/TopPage.

The sharp decline in GDP and government revenues as a share of GDP in the early years after the transition to capitalism (caused by factors such as the growth of the private and informal sectors where tax compliance was lower, a shrinking of traditional tax bases such as state-owned enterprises, and pressures for tax cuts from a population experiencing declines in real income) had dramatic consequences for the health sector organization in the countries of the ECA region, owing above all to substantial cuts in government health expenditures. A number of countries responded to the challenges of protecting health spending and improving performance in the sector by changing the health financing mechanism after transition, from tax-finance towards social health insurance arrangements.[9] A purchaser-provider split was introduced in three-quarters of the ECA countries—yet sometimes without the typical reliance of health insurance systems on payroll taxes as the main source of health care funding, for instance in Latvia and Poland—and was normally accompanied by the introduction of contracting with both public and private providers. Contracting with private hospitals was permitted and implemented in practice in about half of the ECA countries at some point between 1990 and 2004; private providers contracted even more frequently in primary care. Nonetheless, selective contracts seem to have been actually used in less than half of the countries where a purchaser-provider split was introduced.

Several countries of the region also tried to rationalize spending and improve performance by reforming the way primary care providers and hospitals (the biggest spenders in a health sector) are paid, with or without a switch to social health insurance. For the payment of primary care doctors, salaries were often replaced over

[9] Wagstaff and Moreno-Serra (2008) describe the evolution of this process in the ECA region and investigate the consequences of social health insurance adoption on a number of health sector outcomes.

the 1990s and early 2000s by systems based mainly on capitation, complemented by fees paid for preventive actions such as vaccinations, strip tests, cancer screening and electrocardiograms, plus salaries in some cases. This is the case, for instance, of Estonia, Latvia and the Slovak Republic. Countries such as Albania, Bulgaria and Hungary had pure capitation-based systems in place for primary care doctors at some point during the 1990s, whereas others introduced mixtures of salaries and capitation (e.g. Moldova and Turkmenistan). In about a third of the cases, payment reforms in primary care took place at the same time countries reformed their hospital reimbursement systems—e.g. in Armenia, Poland and the Slovak Republic—yet most countries switched from salaries in primary care without concurrent changes in hospital payment, and sometimes before reforming their hospital reimbursement systems for the first time (Hungary and Romania are examples of the latter). Overall, around two-thirds of the ECA countries changed the way they pay primary care physicians at least once between 1990 and 2004. Finally, six former USSR republics and other countries (such as Serbia and Montenegro) maintained the old salary-based payment system for primary care doctors during the whole period of study.

For hospitals, most ECA countries abandoned historical budgets—a payment system normally based only on *provider* characteristics—as the primary hospital reimbursement method in favor of new payment mechanisms based on characteristics of the *services* provided or *patient* characteristics. These new payment arrangements can be assigned to two broad categories: fee-for-service (FFS) variants and patient-based payment (PBP) methods. The former category includes reimbursement mechanisms whereby hospitals are paid for each service provided to a patient, i.e. by per diem or bed-days, and also per procedure (hospital inputs such as laboratory tests, drugs, surgeries and specialist consultations). In the second category, PBP arrangements, hospital reimbursement is mainly based on patient characteristics such as their diagnoses (primarily under a locally formulated version of DRGs), age or health insurance status.[10]

Figure 1 presents the timing of changes in the predominant hospital payment method between the three reimbursement categories—historical budgets, FFS and PBP—in the countries of the ECA region, for the period 1990-2004.[11] The figure also shows the pattern of introduction of prospective global budgets (caps on the amount reimbursed or services provided at the hospital level) in these countries, normally used alongside FFS or PBP. By 1995, eight of the 28 ECA countries had already moved away from historical budgets as the predominant hospital payment method, namely Croatia, Czech Republic, Estonia, Hungary, Latvia, Macedonia, Slovak Republic and Slovenia. In all but one of these cases, FFS variants—often mixtures of per diem and per procedure methods—were the preferred approach to first replace the Semashko norms (even if only for a short period of time, as in Macedonia). Local versions of global budgets for hospitals were introduced alongside FFS at some point of the early 1990s in the Czech Republic, Latvia and Slovenia, whereas in Lithuania reimbursement caps were introduced and used when line-item budgets were still the predominant payment method for most hospitals. By contrast, only in Hungary was PBP chosen as the predominant hospital payment method prior to 1995, although social health insurance agencies in other countries (such as Kazakhstan, Lithuania and the Russian Federation) experimented with simple DRG or case-based approaches before that date. It has been argued that, in addition to the hoped-for benefits in terms of increased hospital productivity and revenues, the new payment methods introduced

[10] See Ellis and Miller (2008).

[11] Predominant hospital payment methods are defined according to their weight in terms of local hospitals' total revenues.

in the first half of the 1990s were often selected because of their limited data and capacity requirements.[12]

The different degrees of technical expertise and success to achieve the desired protection of health spending levels and system performance between countries led most of the "early reformers" to make additional adjustments to their reimbursement systems in the second half of the 1990s and early 2000s. Thus, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Slovak Republic and Slovenia all reformed the predominant hospital payment method for a second (or third) time after their initial move away from line-item budgets, often by adding global budgets to their current reimbursement arrangement (e.g. Croatia, Estonia) but also by moving towards PBP methods (e.g. Czech Republic, Slovenia).[13] Moreover, other countries switched from budgets for the first time in the same period—such as Armenia, Kyrgyz Republic and Poland—and even adopted a new payment system as late as 2004 (Moldova). In the latter group of countries, payment reforms tended to favor the introduction of DRG systems with distinct degrees of complexity, sometimes accompanied or followed by the implementation of global budgets at the hospital level as an attempt to limit potential increases in spending encouraged by the new reimbursement methods.

3. Likely effects of provider payment reforms

We discuss next the possible impacts of the "new" reimbursement methods introduced into the ECA countries during the 1990s on our selected health sector

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[12] Dixon et al. (2004).

[13] Interestingly, at the end of 1998, the Slovak Republic reverted from per diem reimbursement for hospitals towards a system of budget payments based mainly on historical costs, which was the predominant arrangement until 2002 when DRGs were introduced.

indicators. These include indicators of hospital activity, national health spending and mortality amenable to health care. For convenience, Table 1 summarizes our hypothesized effects (as well our main results).

Hospital admissions. We hypothesize that a shift to FFS or PBP is likely to increase admissions, because unlike hospitals financed through budgets, hospitals financed via FFS and PBP gain financially from additional admissions.[14] The gain is potentially greater for a PBP-paid hospital because a FFS-paid hospital may be able to earn additional revenues from existing patients, by delivering more diagnostic tests, more intensive treatment, and so on. Hence, while we expect the effect on admissions of shifting from budgets to FFS and to PBP to be positive, we expect a shift to PBP to produce the larger impact.[15]

Average length of stay. We hypothesize that shifting from budgets to PBP is likely to reduce average length of stay (ALOS), while a shift from budgets to FFS may or may not reduce ALOS. A PBP-paid hospital gains no extra revenue from keeping a patient an extra day, and forgoes the revenue that could have been earned on a new admission.[16] A budget-paid hospital also gains nothing from keeping a patient in hospital an extra day but since its revenue would not increase if it discharged the patient early and admitted another there is no opportunity cost to keeping the patient in an extra day. A FFS-paid hospital, by contrast, may be able to earn extra profits from keeping a patient in hospital longer. This depends on the type

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[14] See, for instance, Ellis and McGuire (1986), Ellis (1998) and Jegers et al. (2002).

[15] Theoretically, smaller positive impacts of PBP and FFS on admissions compared to line-item budgets may well be the case if hospitals are able to select the most profitable patients, that is, those who would result in higher net revenues for a given hospital due to their DRG rates (in the case of PBP) or typical length of stay, type and number of medical procedures (in the case of FFS arrangements).

[16] See Frank and Lave (1989) and Jegers et al. (2002), among others.

of FFS system in place. Some countries have operated a pure per diem FFS system.[17] The incentive in this case depends on whether reimbursement rates are set above the marginal cost of an additional day. If they are, hospitals have an incentive to keep patients in longer; if they are not, hospitals do not.[18] Other countries have a FFS system where providers are paid only per procedure. In this case, the incentive is to limit ALOS and treat patients more intensively on the days they are in hospital.[19]

Beds and bed occupancy rates. Hospitals paid by historical budgets have a strong incentive to maintain high bed stocks since budgets are often based (and were based under the old Semashko system in the ECA region) on the number of beds.[20] However, they have little incentive to keep their beds full. The effect on beds and bed-occupancy rates of shifting from budgets to FFS or to PBP depends on how the payment change affects the number of inpatient days; the latter is equal to the product of the number of admissions (N) and ALOS (S), which by the bed occupancy constraint must also equal the number of beds (B) multiplied by the bed occupancy rate (R) times 365:

(1) $$N \cdot S = B \cdot R \cdot 365 .$$

Our hypothesized effects on inpatient days of shifting from budgets to FFS and PBP are ambiguous: shifting to PBP is hypothesized to raise admissions but reduce ALOS, while shifting to FFS is hypothesized to raise admissions (albeit by less) and may

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[17] This was the case, for example, in Latvia (until 1996) and the Slovak Republic.

[18] The latter supply response was identified by Frank and Lave (1989) in the context of the American states' Medicaid reimbursement policies.

[19] Macedonia (1991) and the Czech Republic (1995-96), for example, introduced "pure" per procedure mechanisms. The fact that most countries who implemented FFS in our sample actually opted for mixed per diem/per procedure mechanisms during the period of study (e.g. Croatia, Estonia and Romania) makes even more ambiguous the expected impact of our broad FFS category on ALOS.

[20] It is therefore of little surprise that the vast majority of the former communist countries of the ECA region entered the 1990s with an oversupply of hospital beds and excess capacity in general. See, among other reports, the World Health Organization's *Health Systems in Transition* (HiT) series.

increase or decrease ALOS. In both cases the effect on inpatient days (the left-hand side of (1))—and hence the product of the bed occupancy rate and the bed stock (the right-hand side of (1)—is ambiguous. However, it seems reasonable to hypothesize that unlike budget-paid hospitals, FFS-paid and PBP-paid hospitals have little incentive to have beds lying empty, and therefore insofar as they are able to adjust their bed stocks, as they shift from budgets to either alternative method, hospitals will, ceteris paribus, try to increase the bed-occupancy rate.

Cost per admission and quality. We are not able to explore impacts on these aspects of hospital care, but they are clearly important influences on two variables we are able to include in our empirical analysis: total health expenditure and amenable mortality. So, it is worth spending a few moments hypothesizing about the impacts of different payment mechanisms on them.

The budget-paid hospital has no incentive to worry unduly about cost per admission or quality; if budgets are tight, hospitals might admit large numbers of patients and skimp on quality.[21] A PBP-based hospital, by contrast, has a definite incentive to minimize its cost per admission, since it keeps any shortfall from the amount paid for the casetype in question. So, we hypothesize that shifting from historical budget to PBP is likely to result in a reduction in cost per admission. Insofar as some of the cost reduction is achieved by applying less inputs (including through a shorter ALOS), this may compromise the quality of care, depending on the value-added in terms of health status of the reduced inputs. The effect on cost per admission of shifting from budgets to FFS, by contrast, is unclear a priori. The FFS-paid hospital will balance the extra profits from admitting more patients against the extra profits

[21] Cf. e.g. Jegers et al. (2002).

from treating existing patients more intensively. Given the scope for generating additional revenues from already admitted patients, its cost per admission may well end up higher than the cost per admission in a budget-paid hospital. And insofar as the extra services are associated with marginal increments in health status, the effect on quality of a shift from budgets to FFS may also be expected to be positive.[22] Much will depend on the fee schedule: the more generous it is, the more hospitals will be happy to earn additional revenues by increasing the cost per admission, and the more tilted the schedule is toward medically effective services, the more beneficial this will be for patients' health status.

Total hospital costs and total health spending. Shifting from budgets to FFS is hypothesized to increase admissions and may increase costs per admission. Total hospital costs ought, therefore, to increase. By contrast, shifting from budgets to PBP is also hypothesized to increase admissions but the cost per admission is likely to fall; the effect of shifting from budgets to PBP on total hospital spending is therefore ambiguous a priori.

The effects on a country's total *health* spending will depend on the reform's impact on total costs in the hospital sector, but also on costs elsewhere in the sector. It seems likely that both FFS and PBP entail higher administrative costs than a budget-based payment system—billing costs, the costs of monitoring and adjusting schedules, etc. The impacts on total health spending also depend on any adjustments that occur elsewhere in the health system. For instance, if encouraged by the new high-powered incentives hospitals who were previously paid by budget begin admitting patients who could perfectly well have been treated in an ambulatory or a community-care setting,

[22] See Ellis and McGuire (1986); Frank and Lave (1989); and Ellis (1998), among others.

system costs are likely to rise. Shifting away from historical budgets to both FFS and PBP is also likely to have implications for the *number* of hospitals in the system. For example, the payment change may result in new (private) entrants into the hospital market. If the old hospitals contract (as in most ECA countries), there may be some loss of economies of scale, or not depending on where they are relative to their minimum efficient scale, and where the new entrants are relative to theirs. The overall effect will also depend on where the new entrants' cost curves lie in relation to the incumbents'.

Health status. As a result of the potential variations in rates of throughput, quality of care and health spending, one could reasonably expect such changes to be reflected also in different rates of mortality, if only mortality amenable to health care.[23] FFS systems may encourage providers to raise cost per admission by treating patients more intensively than under a budget system, potentially leading to increased quality of care and resulting in better health status as measured, for instance, by avoidable hospital deaths. The actual effect will depend on how medically effective the additional services provided under FFS are. By contrast, PBP methods seem likely to stimulate reductions in cost per admission which may end up in patients being underserved, thus leading to lower quality of care than under budgets or FFS systems. Again, the impacts of shifts from budgets to PBP on health status will depend on how the likely reductions in cost per admission are achieved; if PBP-paid hospitals tend to discharge patients earlier than appropriate, or limit admissions of complex cases, or cut back on beneficial inputs (e.g. diagnostic exams and personnel time), switches from budgets to PBP methods could lead to adverse effects on amenable mortality.

[23] Nolte and McKee (2008).

4. Methods

In order to assess the aggregate impacts of provider payment methods on system-wide health sector outcomes, we implement an empirical approach analogous to that adopted in our previous paper which investigates the impacts of social health insurance adoption in the ECA region (Wagstaff and Moreno-Serra 2009), to which the reader is referred for more details.

Let y_{it} be the health sector outcome of interest in country i at time t, X_{it} be a vector of covariates which might potentially influence both the outcome and the provider payment method in place, and FFS_{it} and PBP_{it} be dummy variables taking on the value of 1 if country i at time t has a fee-for-service or patient-based payment system as the predominant hospital reimbursement method, respectively (the base category is "historical budgets/block grants"). The basic model is expressed as:

$$(2) \qquad y_{it} = X_{it}\gamma + \delta FFS_{it} + \varphi PBP_{it} + e_{it}$$

where the term e_{it} captures unobservables and noise. The coefficients of interest are δ and φ, which give the impacts of fee-for-service and patient-based payment methods (respectively) on the outcome y_{it}. If the payment method dummies are correlated with e_{it} (i.e. the choice of hospital reimbursement method is endogenous), estimation of eqn (2) by pooled OLS would result in a biased estimate of δ and φ. It could be, for example, that countries with unobserved characteristics that led to higher-than-expected levels of health spending may deliberately avoid paying hospitals through fee-for-service arrangements because of the associated incentives towards increased health service production and spending in such environment. Or it might be that other important institutional changes or events occurred broadly around the same time that the countries changed their predominant hospital payment method. If we fail to capture these in our model but instead implicitly include them in e_{it}, and if they affect the outcomes of interest, our estimates of δ and φ will be biased. We use a basic difference-in-differences estimator and two generalizations of that approach to account for the possible endogeneity of the payment method dummies.

4.1 The differences-in-differences model

The simplest way to allow for such a correlation is to let:

$$(3) \qquad e_{it} = \alpha_i + \theta_t + \varepsilon_{it} \, ,$$

where θ_t is a period-specific intercept, α_i is a country-specific effect which captures time-invariant unobservables that are potentially correlated with the provider payment method in place, and ε_{it} is an idiosyncratic error term (iid over i and t). Substituting eqn (3) in eqn (2) gives

$$(4) \qquad y_{it} = X_{it}\gamma + \delta FFS_{it} + \varphi PBP_{it} + \alpha_i + \theta_t + \varepsilon_{it} \, .$$

Taking first differences of eqn (4) gives

$$(5) \qquad \Delta y_{it} = \Delta X_{it}\gamma + \delta \Delta FFS_{it} + \varphi \Delta PBP_{it} + \xi_t + \Delta\varepsilon_{it} \, ,$$

which can be consistently estimated by pooled OLS if the endogeneity of the payment method choice is adequately captured by the error term specified in eqn (3).[24]

[24] Standard errors need to be adjusted for clustering at the country level to allow for serial correlation (cf. Bertrand et al. 2004; Cameron and Trivedi 2005 p.705).

4.2 The random trend model

The generalized difference-in-differences (DID) estimator shown above assumes a parallel or common trend: the θ_t do not depend on the values of FFS_{it} and PBP_{it}, and therefore the health systems that switch from historical budgets to either FFS or PBP (or between FFS and PBP) exhibit the same trend among them, and the same trend as the “untreated” countries that remain with budgets as the predominant reimbursement method over the entire period of study. In reality, there may be time-varying unobservables that are correlated with both y_{it} and the choice of provider payment arrangement. A model that allows this parallel trend assumption (PTA) to be relaxed is the “random trend” (RT) model (cf. e.g. Wooldridge 2002 p.316). Eqn (3) is replaced by the assumption

(6) $$e_{it} = \alpha_i + \theta_t + k_i t + \varepsilon_{it} .$$

This allows for the possibility that different countries have different trends, as reflected in different values of k_i. Substituting eqn (6) in eqn (2) gives

(7) $$y_{it} = X_{it}\gamma + \delta FFS_{it} + \varphi PBP_{it} + \alpha_i + \theta_t + k_i t + \varepsilon_{it} ,$$

which can be estimated by differencing eqn (7) and using a fixed effects estimator on the resultant equation:

(8) $$\Delta y_{it} = \Delta X_{it}\gamma + \delta \Delta FFS_{it} + \varphi \Delta PBP_{it} + \xi_t + k_i + \Delta\varepsilon_{it} .$$

If the k_i are jointly insignificant, eqn (8) collapses to eqn (5), which would provide evidence in support of the PTA. Yet even if the k_i were jointly significant, the PTA would still be a reasonable assumption if the k_i are uncorrelated with FFS_{it} and PBP_{it}.

The latter can be tested for each outcome of interest through a (two-variables) generalized version of the Hausman test of fixed versus random effects which takes into account the clustered nature of our data and is implemented by estimating an auxiliary quasi-demeaned regression (cf. Wooldridge 2002 p.290). For each dependent variable, we implement this test by estimating an augmented version of eqn (8) using a random effects estimator—adding the within-country panel means of the original covariates which vary over i and t as regressors—and testing the null hypothesis of joint insignificance of the two additional payment methods terms (with cluster-robust standard errors). Non-rejection of this hypothesis would suggest that the k_i are uncorrelated with FFS_{it} and PBP_{it} and thus provide evidence in favor of the parallel trend assumption.

4.3 The differential trend model

The RT model is less restrictive than the standard DID model (the latter is nested in the former), but nonetheless suffers potentially from two problems: the assumed trend is linear; and the trend is specific to the country and assumed not to be modified by a change of the hospital payment method in place. Another model that allows the PTA to be relaxed is a generalization of the "differential trend" (DT) model of Bell et al. (1999). We assume:

$$(9) \qquad e_{it} = \begin{cases} \alpha_i + k_f m_t + \varepsilon_{it},\ if\ FFS_{it} = 1; \\ \alpha_i + k_p m_t + \varepsilon_{it},\ if\ PBP_{it} = 1; \\ \alpha_i + k_b m_t + \varepsilon_{it},\ otherwise. \end{cases}$$

In this specification, m_t is an unobserved trend, the influence of which on y_{it} is allowed to differ between health systems according to their predominant hospital payment method: FFS, PBP or budgets. Incorporating this assumption into eqn (2) gives:

(10)
$$\begin{aligned} y_{it} &= X_{it}\gamma + \delta FFS_{it} + \varphi PBP_{it} + \alpha_i + k_b m_t \\ &\quad + \left(k_f - k_b\right) m_t FFS_{it} + \left(k_p - k_b\right) m_t PBP_{it} + \varepsilon_{it}, \end{aligned}$$

from which we can get a first-differenced estimating equation:

(11)
$$\begin{aligned} \Delta y_{it} &= \Delta X_{it}\gamma + \delta \Delta FFS_{it} + \varphi \Delta PBP_{it} + k_b \Delta m_t \\ &\quad + \left(k_f - k_b\right) \Delta\left(m_t FFS_{it}\right) + \left(k_p - k_b\right) \Delta\left(m_t PBP_{it}\right) + \varepsilon_{it}. \end{aligned}$$

In the estimation, the Δm_t are replaced by first differences of year dummies, and $\Delta(m_t FFS_{it})$ and $\Delta(m_t PBP_{it})$ are replaced by first differences of interactions between year dummies and the hospital payment dummies. The estimating equation is thus:

(12)
$$\begin{aligned} \Delta y_{it} &= \Delta X_{it}\gamma + \delta \Delta FFS_{it} + \varphi \Delta PBP_{it} + \sum\nolimits_{\tau=2}^{T} \beta_\tau \Delta YEAR_\tau \\ &\quad + \sum\nolimits_{\tau=2}^{T} \eta_\tau \Delta\left(YEAR_\tau FFS_{it}\right) + \sum\nolimits_{\tau=2}^{T} \psi_\tau \Delta\left(YEAR_\tau PBP_{it}\right) + \Delta\varepsilon_{it}, \end{aligned}$$

which can be estimated by pooled OLS. In this model the impact of each alternative provider payment method varies over time, but one can estimate the average impact of FFS and PBP over time:

(13)
$$\begin{aligned} &MEAN\ FFS\ IMPACT = \hat{\delta} + \sum\nolimits_{\tau=2}^{T} \hat{\eta}_\tau / T - 1; \\ &MEAN\ PBP\ IMPACT = \hat{\varphi} + \sum\nolimits_{\tau=2}^{T} \hat{\psi}_\tau / T - 1. \end{aligned}$$

The PTA assumption in this model implies k_f=k_p=k_b. This can be tested indirectly by jointly testing two nonlinear restrictions:

$$
(14) \quad \begin{cases} \dfrac{\sum_t m_t \left(k_f - k_b\right)}{\sum_t m_t k_b} = \dfrac{\left(k_f - k_b\right)\sum_t m_t}{k_b \sum_t m_t} = \dfrac{\sum_{\tau=2}^{T} \eta_\tau}{\sum_{\tau=2}^{T} \beta_\tau} = 0 \\ \dfrac{\sum_t m_t \left(k_p - k_b\right)}{\sum_t m_t k_b} = \dfrac{\left(k_p - k_b\right)\sum_t m_t}{k_b \sum_t m_t} = \dfrac{\sum_{\tau=2}^{T} \psi_\tau}{\sum_{\tau=2}^{T} \beta_\tau} = 0 \end{cases}
$$

4.4 Testing for reverse causality

Although our DID, RT and DT models all allow for some correlation between the payment method in place and the original error term e_{it}, they entail specific assumptions that may not adequately capture the endogeneity of the hospital payment dummies. It has long been recognized that governments tend to reform the provider payment methods in place as a response to the aggregate trajectory of the health sector (Newhouse 1977); for instance, a country may change its predominant hospital reimbursement system exactly as a way to tackle historically high or increasing health spending. Reverse causality of this form is likely to be present in most cross-country analyses dealing with the impacts of the different institutional characteristics of health systems and, if also present in our data, means that difference-in-differences generalizations of the sort described above will not properly capture the endogeneity of provider payment methods.

An informal yet intuitive test of reverse causality based on that proposed by Gruber and Hanratty (1995) in a similar modelling exercise is to include in each of our three models two lead dummy variables, the first indicating whether a FFS method will be adopted the following year, and the other indicating whether a PBP arrangement will be introduced in the following year. If, in our models, causality goes from the provider payment method in place to the outcome variable, the coefficients on the lead dummies will be zero. Nonzero coefficients would point towards causality running the other way or some other type of endogeneity that cannot be captured by the model in question. We perform reverse causality tests for all the models estimated in this paper.

5. Data

We use annual data on provider payment methods in place and health sector outcomes for the 28 ECA countries, from 1990 to 2004.[25] Our dataset has been constructed using a variety of sources; the description in this section begins with our independent variables of interest, hospital payment methods, and then continues for our other variables.

5.1 Hospital payment methods

We have used information contained in a number of sources—mainly the World Health Organization's *Health Systems in Transition* (HiT) series, in addition to personal communications with World Bank staff and a variety of country reports—to classify a country's predominant hospital payment method in a given year as (*i*) historical budgets or block grants (the prevailing method under the communist Semashko system), (*ii*) fee-for-service (FFS), or (*iii*) patient-based payment (PBP). Our FFS dummy is defined as taking the value of one at time t if hospitals in country i are mostly reimbursed (i.e. derive the majority of their revenues) through variants of the "classic" FFS arrangement in which hospitals are paid per procedure; arrangements whereby hospitals are reimbursed mainly by per diem variants; or a mixture of both arrangements. Our PBP_{it} variable takes the value of one if the main

[25] In the case of Bosnia-Herzegovina, the period between 1992 and 1996 has been excluded from the analysis due to the lack of data for some variables and the complete disorganization of the health system during the war period.

hospital payment method in country i at time t is based instead on patient characteristics—rather than characteristics of the providers or services offered—including per case, DRG-based and similar prospective methods (cf. Ellis and Miller 2008).[26]

Of the 28 countries in our sample, 17 switched from the use of historical budgets to either FFS or PBP as the main hospital reimbursement method at some point between 1990 and 2004 (see Figure 1); some switched to FFS or PBP and stuck with the chosen method, while others switched subsequently between these two arrangements. Our FFS and PBP dummies are equal to 1 in around 19% and 21% (respectively) of the typical estimation sample for a given health outcome.

5.2 Outcome variables

Our system-wide health outcomes include: hospital activity rates and capacity utilization; per capita health spending; and seven measures of mortality, all corresponding to causes of death with an important component amenable to health care.[27] Variable definitions and sources are briefly described below.

Our indicators of hospital activity and capacity utilization are the number of inpatient care admissions and five disease-specific discharges (circulatory, cerebrovascular, respiratory, digestive, and musculoskeletal system diseases); the

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[26] We follow the previous empirical literature by establishing predominant payment methods for each country-year combination (see, for instance, Gerdtham and Jonsson 2000), in light of the information contained in a variety of sources and the theoretical classification of provider payment methods suggested by Ellis and Miller (2008). Since, at any given year, countries may use a mix of FFS and PBP methods to reimburse hospitals for a given type of service provided, no "all inclusive" classification is free from criticism. For those country-year combinations where a secondary payment method also seemed important in terms of hospital revenues as far as we could establish (e.g., by accounting for 40% or more of the local hospitals' reimbursement), we explore the robustness of our results to reclassifying the countries according to the relevant secondary payment method and re-running the models (see Section 6).

[27] Unfortunately, we were unable to find usable panel data on costs per admission for our sample of ECA countries.

average length of stay for all hospitals; the number of beds; and the bed occupancy rate. Except for the number of beds which was taken from the World Bank's *World Development Indicators* (WDI) database, the source for hospital-level data was the World Health Organization's *Health for All* database.

Annual health spending per capita (total and disaggregated as public and private spending) was obtained from the WDI database and is measured in constant 2000 dollars adjusted for purchasing power parity. The *Health for All* database was the source for the seven amenable mortality indicators investigated here: these are the standardized death rates for ischemic heart disease, diabetes, cerebrovascular diseases, female breast cancer, appendicitis, hernia and intestinal obstruction, and adverse effects of therapeutic agents.

Descriptive statistics are shown in Table 2 for the full sample—across the whole period of study and all countries—and separately according to the predominant hospital reimbursement method observed. Country-year combinations with reimbursement by PBP and, especially, FFS present higher hospital activity rates, as reflected by more inpatient admissions and generally higher numbers of disease-specific discharges. PBP systems exhibit lower average length of stay and fewer hospital beds than either FFS or budget systems, and FFS observations present the highest bed occupancy rates. In our sample, total health expenditures are considerably higher for PBP and FFS country-year combinations than in those combinations where historical budgets were observed, with FFS associated with the highest average total spending and substantially higher public spending. Finally, budget systems exhibit higher amenable mortality rates than FFS and PBP for four of the seven causes of death, yet neither FFS nor PBP observations clearly dominate in terms of mortality improvements vis-à-vis budgets. Our empirical work investigates whether the relationships described above represent causal effects from the introduction of different provider payment methods across countries or are mere correlations reflecting selection effects.

5.3 Covariates in the estimating equation

We follow most of the previous empirical literature (see Gerdtham and Jonsson 2000) and include as covariates in our models GDP per capita (measured in constant 2000 dollars and purchasing power adjusted), the share of the population aged 65 or above, and the urban population as a fraction of the total. Data on these three covariates come from the WDI database. Following Wagstaff and Moreno-Serra (2009), who found that the introduction of social health insurance (SHI) in many countries of the ECA region during the 1990s had impacts on some of the outcomes examined in this study, we include in the covariates set a dummy variable for whether the country has a SHI system in place in a given year.[28]

As described in Section 2, a number of ECA countries reformed also the way primary health care providers are paid, in addition to payment reforms in inpatient care. In some countries, payment reforms for primary care providers and hospitals were implemented simultaneously, whilst in most instances (two-thirds) they took place at different points in time between 1990 and 2004. It seems important to isolate the impacts of payment reforms in primary care for the ECA countries not only because such reforms have occurred in budget, FFS and PBP systems alike, but especially because, where hospital and primary care payment reforms were coupled,

[28] Tax-financed system is the reference category. For the subset of SHI countries, switches between hospital payment methods did not occur in the same year as SHI adoption in 60% of the cases. For more details on the data sources, construction of the SHI dummy and the resulting classification of countries as tax-financed or SHI systems, see Wagstaff and Moreno-Serra (2009).

this occurred differently and may have introduced distinct incentives across health care systems. For example, in a few countries hospitals started to be reimbursed by DRG at the same time that payment to primary care doctors changed from salaries to mainly capitation, likely providing more incentives for physicians to refer patients to hospitals (and for hospitals to admit these additional patients) than in countries where DRG introduction in inpatient care was accompanied by a predominant FFS arrangement for primary care doctors. In order to control for the effects of contemporaneous primary care payment reforms, we include in our models three dummy variables indicating the presence of salaries, capitation and fee-for-service methods for paying doctors in a given country-year combination. We also include, in our vector of covariates, a dummy variable for whether prospective global budgets (caps in reimbursement or services provided) were in place at the hospital level, as in a minority of cases these were implemented alongside the introduction of PBP or FFS and may affect the response of hospitals to the new payment methods. The data sources for the primary care payment and global budget dummies are the same used to construct the hospital payment indicators.

6. Results

We present first the results of the specification tests, followed by the estimates of the impacts of provider payment reforms on our health sector outcomes.

6.1 Specification tests

The first columns of Table 3 report the results of the parallel trend assumption (PTA) tests for our random trend and differential trend models, i.e. applied (respectively) to eqns (8) and (12), and the preferred specification implied by the PTA tests for each health sector outcome. The PTA, and hence our basic difference-in-differences (DID) model described by eqn (4), is rejected at conventional levels of significance in five instances in favor of the random trend model (for cerebrovascular and digestive system diseases, bed occupancy rate and death rates for ischemic heart disease and diabetes) and in one instance in favor of the differential trend model (hospital beds). We thus focus on the differential trend model results for the number of beds, and on the random trend model results for the former five outcomes; for the remaining dependent variables, the data seem consistent with the PTA and, consequently, we focus on the results from the basic DID model.

According to the results from the reverse causality tests reported in the last three columns of Table 3, the preferred models for each outcome account adequately for the potential endogeneity of provider payment reforms in our sample of countries. Of the 19 outcomes selected for our study, the only case for which the joint insignificance of the lead payment dummies is rejected at conventional levels in the corresponding preferred model is the death rate for diabetes; for this particular variable, we must acknowledge that the preferred specification does not seem suited to provide reliable estimates of the impacts of provider payment reforms.[29] Nonetheless, for all the remaining health sector outcomes in the present empirical work, our econometric specifications appear to be well-suited to the task in light of the available evidence.

[29] Similar results are obtained if the basic DID or DT models are used instead for this specific outcome. All sets of results mentioned in this paper but not shown are available from the authors upon request.

6.2 Main estimates

Table 4 reports the coefficients for the two hospital payment dummies (and associated p-value for the null hypothesis of a zero coefficient) estimated in the preferred specification for each health sector outcome. Also shown are the FFS and PBP percentage impacts implied by the corresponding coefficients, calculated over the mean outcome variable in the corresponding estimating sub-sample. Our main findings (that reflect our main results and the results of our sensitivity analyses reported below) are summarized for convenience in Table 1.

Hospital admissions. The results suggest that the introduction of FFS as the main hospital reimbursement method in preference to historical budgets (holding constant primary care payment methods and the presence of prospective global budgets for hospitals) increases total admissions. This is in accordance with our hypothesized impact, yet the point estimate from the preferred model implies a relatively small effect (just 2%). This positive impact of FFS seems to occur across all types of admissions: we observe statistically significant increases for all except one measures of hospital discharges—circulatory, respiratory, digestive and musculoskeletal system diseases; the preferred models suggest positive impacts ranging from 6-8%. By contrast, and contrary to what we were expecting, there seems to be no impact on inpatient admissions of a shift from historical budgets to PBP methods, a result which is corroborated by the general absence of statistically significant estimated impacts (and small point estimates) of PBP methods on our discharge measures.

Average length of stay. Shifts from budgets to FFS do not seem to affect the average length of stay (ALOS): our point estimate is negative but statistically insignificant. By contrast, and consistent with our expectations, switches from budgets to PBP *do* lead to a statistically significant reduction of 3.5% in ALOS.

Beds and bed occupancy rates. Because FFS (relative to budgets) seems to raise the number of admissions without reducing ALOS, it increases the number of inpatient days. By the bed occupancy constraint—eqn (1)—there should be a corresponding increase in the number of beds and/or the bed occupancy rate. In the event, however, we find that neither is affected by FFS introduction: despite being of the expected positive sign, the preferred coefficient estimates are nowhere near being statistically significant. By contrast, because PBP leads to no change in admissions but reduces ALOS, we should expect the implied fall in inpatient days to be accompanied by reductions in the number of beds and/or the bed occupancy rate. Indeed, we find that PBP introduction leads to an average 5% decrease in the bed occupancy rate compared to budgets, and a negative but statistically insignificant effect on the number of beds.

Total health spending. According to the results of the specification tests, the simplest model consistent with the data on health spending per capita is the basic DID specification, which is estimated using eqn (5). The preferred model points to a sizeable increase of about 20% in national health spending in countries that introduced FFS as the main hospital reimbursement method in preference to budgets (again holding constant factors such as payment methods in primary care and the existence of global budgets). This estimated impact is statistically significant at the 1% level and is equivalent to FFS increasing annual total spending by around $81 per capita, compared to the situation when historical budgets were the prevailing payment method. In relative terms, around 36% of the estimated rise in total health spending associated with the shift to FFS is due to increased private spending: we estimate a statistically significant rise of about 28% (or $29 per capita) per year on this component due to FFS introduction, whereas the statistically significant point estimate for public spending per capita indicates a smaller proportionate increase of around 17% (or $52 per capita).

The estimated rise in national health spending brought about by paying hospitals through FFS methods rather than budgets (20%) is much larger than the corresponding estimated increase in admissions (2%). There are two possible explanations. One is that the extra spending was confined to the hospital sector, and that the average cost per admission increased (by a sizeable magnitude) after the introduction of FFS. The difference between the estimated percentage increases in total spending and admissions, of around 18 percentage points, indirectly provides an upper bound for the impact of FFS on the cost per admission.[30] The other explanation is that the shift to FFS in the hospital sector raised spending throughout the health system, not just in the hospital sector. Spending on other types of care (e.g. ambulatory care and drugs) may have increased, but so too may administrative costs. In the absence of adequate panel data on cost per admission, we are unable to distinguish between these two competing explanations.

Adopting PBP methods over historical budgets also appears to lead to higher total health spending. Switches to PBP raise annual national health spending per capita by around 11% (or $46). Similarly to the FFS case, the rise in private spending seems to have been a major force behind the increase in total expenditures, with a

[30] Directly testing the hypothesis of increased costs per admission in FFS systems is not possible here, unfortunately, due to the previously noted unavailability of usable panel data on such variable for the ECA countries.

statistically significant point estimate of around 23% ($24). The point estimate for public spending suggests a smaller though statistically insignificant percentage rise of about 7% ($22) on this component due to PBP arrangements. Again, the extra spending could have been due to an increase in expenditure per admission, or to extra spending elsewhere in the health system. It is worth noting that, although the magnitudes of the point estimates for our three health spending variables are larger for FFS than PBP methods, Wald tests of the hypothesis of equality of the FFS and PBP coefficients cannot reject the null hypothesis, with p-values in excess of 0.4.

Amenable mortality. In spite of the higher hospital activity rates and spending estimated for countries using FFS methods in preference to historical budgets, there is no evidence that the introduction of the former payment method has any effect—either beneficial or deleterious—on amenable mortality. The estimated FFS coefficients are very small in magnitude for the six death causes examined here[31], with negative and positive point estimates evenly distributed (the mean impact is just 0.4%). The p-values are very large, and none of the impacts comes anywhere close to being statistically significant. A different story emerges in the PBP results. We find that PBP significantly reduces amenable mortality for two causes, namely deaths by ischemic heart disease (reduced by around 4% according to the preferred model) and cerebrovascular diseases (diminished by around 5%). Furthermore, all but one of the point estimates is negative, and the magnitudes are considerably larger than in the case of FFS (the mean impact in the PBP results is -7.2%).[32]

[31] Recall that our specification tests indicate that the preferred model in the case of the standardized death rate by diabetes fails to account adequately for reverse causality. For this reason, we do not discuss the regression estimates obtained for this seventh amenable mortality indicator.

[32] In general, no statistically significant or otherwise noteworthy effects on our health sector outcomes are found for the primary care payment methods and global budget dummies in the preferred specifications.

6.3 Robustness of estimates to payment method classifications

As already noted, the analysis reported so far is based on the predominant hospital payment method (in terms of hospital revenues) observed in each country-year combination. Although the predominant payment arrangement at a given time is fairly clear for most countries in our sample, there are some cases where the importance of a second method seems far from being negligible, sometimes reaching one-third or more of the average hospital's funding. We thus explore the sensitivity of the impact estimates reported in the previous sub-section to changing the hospital payment classification for some country-year combinations where such ambiguities exist in view of the available information; the alternative classifications are described in Table 5 and the new impact estimates are reported in Table 6 (Panel A).[33]

Most of the estimated impacts of FFS and PBP on our health sector outcomes change little when the alternative payment method classifications are used, both in terms of the statistical significance of individual coefficients and their magnitude. There are, however, a couple of important changes, namely that a shift to PBP no longer has significant effects on ALOS or amenable mortality.

6.4 Robustness of estimates to allowance for lagged effects

As a second robustness check of our results, we investigate the sensitivity of the estimates to relaxing the restriction that changes in the predominant provider payment method and any resulting changes in outcomes occur contemporaneously, as assumed in the three main specifications estimated in this paper—i.e. equations (5), (8) and (11). It can be argued, for instance, that the impacts of provider payment

[33] In this sub-section, we follow the same empirical methodology described in the previous sub-section as far as specification tests, model selection and estimations are concerned. As before, reverse causality does not seem to be an issue in our data once we employ our regression-based generalizations of the difference-in-differences approach.

reforms on outcomes such as hospital activity rates and amenable mortality indicators may take more than a year to be observed; in this case, the small and insignificant effects estimated for some dependent variables in our original specifications should be strictly interpreted as the absence of *contemporaneous* impacts, and not necessarily as the absence of *any* impacts over time. To address this concern, we expand the original DID and RT models (equations (4) and (7)) by including the first lags of the FFS and PBP dummies alongside the current values of these dummies and all the original covariates.[34] We therefore allow for both instantaneous and (one-year) lagged impacts of provider payment reforms on our health sector outcomes in the expanded specifications, and any differences between the results of the latter and the original specifications for a given outcome in effect signal that there are adjustments after the initial impact (or the absence of it).

Panel B of Table 6 reports the estimated coefficients of the current and lagged values of the FFS and PBP dummies in the expanded models, along with the coefficients given by a linear combination of the current and lagged values for FFS and PBP, and the implied impact estimates by such linear combinations (that is, the cumulative effects of FFS and PBP after a lag of one year). The results from the expanded models tend to confirm those obtained from our original specifications and often provide valuable insights on the temporal pattern of reform impacts.

Hospital admissions. Lagged (positive) effects of the introduction of FFS over budgets seem to be important as far as the number of admissions is concerned, leading

[34] We would have liked to include additional lags of the payment dummies in the models so as to investigate differential impacts of the reforms over time; however, it seems unwise to do so in light of our relatively small sample size. Similarly, the huge burden imposed to the data by estimating an expanded DT model—which requires the inclusion of interactions between the payment dummies and time dummies—has also led us to estimate expanded versions of the DID and RT specifications only.

now to a higher and significant cumulative impact estimate of almost 8% (of which 5% is due to the lagged effect, in addition to the contemporaneous impact estimate of 3%—both estimates significant at the 1% level and the latter close to our original 2% estimate). The originally estimated absence of effects on admissions of replacing historical budgets by PBP arrangements is also generally confirmed in the new specifications.

Average length of stay. Similar results with respect to ALOS emerge with the lagged effects. The shift to FFS has no significant effect, while the shift to PBP decreases ALOS by 4.5% (significant at the 4% level; the difference between the two PBP estimates is just one percentage point and is entirely due to a post-first year adjustment in the dependent variable—not precisely estimated).

Beds and bed occupancy rates. Allowing for adjustments after the initial effects leads to an unearthing of a positive impact of FFS on the bed occupancy rate which matches the estimated increase in admissions; the former is now found to significantly increase by about 8% as well, and the impact is mainly identifiable one year after FFS introduction. In the case of PBP too the bed occupancy rate seems to be positively affected with a lag: a negative contemporaneous point estimate (which has an associated p-value of 0.153 and is equivalent to an impact of about 4%, close to the original impact estimate) is offset by a positive lagged point estimate (equivalent to an impact of 3.5%), resulting in a negative yet small and statistically insignificant cumulative PBP effect.

Total health spending. The expanded models also confirm the sizeable positive effects of FFS adoption on national health spending, both public and private, relative to budgets. Interestingly, all FFS spending impacts are found to occur already in the first year such payment method is in place, and by similar magnitudes to those reported by the original models: the statistically significant point estimates imply contemporaneous FFS effects of around 18%, 16% and 22% on total, public and private spending (respectively), with cumulative impacts of around 18% for each of these indicators (hence, in the new specifications, there seem to be no major differences between the relative, cumulative spending impacts on public and private spending). Furthermore, the new specifications not only confirm the originally found positive spending effects of PBP introduction over historical budgets, but also point to even larger cumulative effects—ranging from around 19-22% for the three spending categories, close to the corresponding FFS impact estimates—once lagged adjustments are taken into account. The statistical insignificance at conventional levels of the linearly combined PBP point estimate for private spending (which nonetheless has a small associated p-value of 0.164) seems to be driven by the fact that such spending variable is once again affected mainly contemporaneously by the reforms—equivalent to a PBP impact of about 19%—with no further (delayed) adjustments. Public expenditures, on the other hand, are increased by approximately 10% with a one-year lag due to PBP adoption (estimated coefficient significant at the 1% level), and the contemporaneous point estimate suggests an additional impact of around 12% (p-value of 0.173), resulting in a cumulative PBP effect of 22% on public spending (significant at the 5% level). Thus, for public spending, the relatively small and statistically insignificant impact of PBP adoption found in the original DID specification is "corrected" by taking into consideration the important lagged effect of PBP introduction on such indicator. Accounting for the latter leads, in turn, to a positive and statistically significant estimate of the lagged PBP effect on total health spending (of around 8%) and a resulting cumulative PBP impact of about 21%, 10 percentage points larger than the estimate previously found in the original DID specification.

Amenable mortality. The general absence of FFS effects (either contemporaneous or with a lag) is still the case according to the results of the expanded models. The new results for PBP adoption are also in accordance with the main impact estimates, indicating a statistically significant cumulative reduction in the death rate for ischemic heart disease (a reduction of around 6%) and negative point estimates for all mortality indicators.[35]

7. Summary and discussion

After the breakup of the Soviet Union and the subsequent transition to capitalism, several Central and Eastern European and Central Asian (ECA) countries aimed at reforming their provider payment systems as an instrument to achieve the general objectives of protecting health spending levels and improving the overall performance of the health sector. This reformist wave provides a unique opportunity to assess empirically the system-wide impacts of different provider payment methods. Most of the major reforms in the ECA region involved, among other elements, a change in the predominant hospital reimbursement method, with some countries switching their payment system more than once after the transition from communism.

[35] Given the comparative nature of our robustness check exercises, we do not discuss the impact estimates for the diabetes death rate; see footnote 31. For consistency, we also estimated the expanded models using the alternative country-year classification of provider payment methods presented in Table 5, obtaining again broadly similar results (not shown) to those reported in the main text. In particular, the point estimates for FFS introduction indicate increases of around 7% and 6% in admissions and the bed occupancy rate (respectively), and contemporaneous positive spending impacts (across the board) of about 17%. As for PBP adoption, the main difference in results is the lack of a statistically significant cumulative impact on ALOS—though we find a significant, negative contemporaneous effect of 2% on this outcome—whereas total health spending is still significantly increased yet by a smaller cumulative estimate of around 13%.

This paper uses the health sector reforms implemented by ECA countries over the 1990s and early 2000s as an “experiment” to investigate empirically the system-wide impacts of introducing fee-for-service (FFS, encompassing both per procedure and per diem mechanisms) and patient-based payment PBP (PBP, mainly per case and DRG-based systems) as the main hospital reimbursement method—relative to the previous communist system of line-item, historical budgets—on a set of outcomes including hospital activity rates and capacity utilization, national health spending, and mortality amenable to health care.

In our empirical work, we use panel data from 28 ECA countries for the period 1990-2004 and employ, in addition to a simpler regression-based difference-in-differences approach, two generalizations of the latter model in order to control for the potential endogeneity of provider payment reforms: a random trend model (allowing for linearly time-changing unobservables which may vary at different rates between countries, and may be correlated with both the choice of hospital payment method and the outcome of interest) and a differential trend model (allowing for non-linearly time-changing unobservables which may vary at different rates between *groups* of countries—i.e. budget, FFS and PBP countries—and may be correlated with the choice of hospital payment method and health outcomes). In the latter two models, we assess the validity of the parallel trend assumption which is inherent to the simpler difference-in-differences approach and use the results of the tests to identify the most suitable model for our data among the three alternatives, for the case of each health outcome. We also formally test for the presence of reverse causality in payment reforms (that is, reforms being driven by changes in our health sector outcomes); in the event, we find that, for all but one of the selected health outcomes, our econometric models perform well in controlling for the potential endogeneity of FFS and PBP introduction in our sample of ECA countries. Importantly, we control for concurrent reforms in the way health systems are funded, i.e. through general tax-financing or social health insurance arrangements; contemporaneous payment reforms in the primary care sector; and the existence of prospective global budgets at the hospital level. We find that our main estimates are mostly robust to changing the predominant hospital payment method classification for countries where there are other important payment systems in place, and to allowing for (one-year) lagged impacts of the reforms in addition to any contemporaneous effects.

Compared to historical budgets and according to the preferred specifications, we find that the introduction of FFS—holding constant payment methods for primary care providers, among other factors—increases inpatient admissions (with widespread effects across different types of admission) but does not affect the average length of stay (ALOS). Both results are consistent with our theoretical expectations. Allowing for lagged effects of payment reform leads to a 7.5% estimated increase in admissions due to FFS. By the bed occupancy constraint, we should expect either the number of beds or the bed occupancy rate to rise; indeed, once lagged adjustments are accounted for, we find that FFS raises the latter indicator by about 8%. Also consistent with our priors, FFS increases health spending per capita by as much as 20% (a contemporaneous effect which is due both to higher current government and private expenditures). This 20% increase coupled with the 7.5% increase in admissions could mean that the cost per admission is increased by a shift from budgets to FFS, or that the shift to FFS increases spending outside the hospital sector. In spite of the increase in health spending, we find no evidence that using FFS in preference to budgets leads to a reduction in amenable mortality.

Turning to the results for PBP, contrary to our expectations, inpatient admissions do not seem to be affected by a shift from budgets to PBP methods; by contrast, PBP adoption does seem to reduce ALOS as expected (by about 4%). The resulting decrease in inpatient days is matched by a commensurate reduction in the bed occupancy rate. Shifting from historical budgets to PBP also increases health spending. Taking into account lagged impacts (mostly relevant to public spending) in addition to the contemporaneous rise in private expenditures, the estimated increase in total spending due to PBP is of around 21%, very close to the corresponding FFS estimate. Given the lack of impact of PBP on admissions, the implication is that PBP—like FFS—increases the cost of a typical hospital admission, or results in substantially higher health spending outside the hospital sector. However, in contrast to the case of the FFS impacts, there is some evidence that switching from budgets to PBP methods may lead to lower amenable mortality. We find significant negative effects on death rates for ischemic heart and cerebrovascular diseases, in addition to point estimates for the remaining measures that are generally negative and larger in absolute size than those for FFS. However, the significance of these estimates is not robust to the changes in payment method classifications, and Wald tests indicate that the FFS and PBP coefficients are not significantly different from one another for any amenable mortality outcome.

What are the most plausible interpretations for the above results? Taken together, our findings that FFS has (*a*) no impact on ALOS and (*b*) a larger impact on health spending than on admissions are consistent with FFS leading to a higher cost per admission. The explanation would be that rising costs are driven by extra procedures being supplied to a given patient and to a lesser degree by additional admissions, rather than by prolonged hospital stays.[36] This line of argument is consistent with previous theoretical and empirical research on the general effects of this reimbursement method (cf. Ellis and McGuire 1986; Yip and Eggleston 2001; among others). However, our results are also consistent with additional health spending occurring *outside* the hospital sector. With our data, we are unable to discriminate between these two hypotheses. Of course, both may be true.

Our results certainly suggest that a sizeable part of the rise in health spending caused by a shift from budgets to FFS is due a rise in *private* spending.[37] Again, this extra spending could be in the hospital sector, or outside the hospital sector. In the latter case, it could be that patients admitted in hospital are incurring expenditures on complementary ambulatory care services or purchasing additional drugs. Or it could be that people are substituting away from hospital care knowing that FFS encourages providers to deliver additional care not all of which may be medically necessary and instead making greater use of ambulatory care and drugs. Our data do not allow us to discriminate between these explanations. And, again, both could be true. Indeed, both are plausible. It does indeed seem to be the case that hospital payment reforms in the ECA countries often entailed not only a decision that the government will pay hospitals differently (leading to higher public spending after the reforms, consistent with the results above), but also a decision that hospitals will be allowed to recover some of their costs from out-of-pocket payments from patients. In many cases, user

[36] With regard to the absence of FFS impacts on ALOS in our sample, it is worth noting that even hospitals in countries where per-diem was the prevailing reimbursement method may have faced no incentives to increase ALOS, relative to the level observed under historical budgets. For instance, in the case of the Slovak Republic, there is evidence that bed day prices did not cover the real costs of hospitals, with costs exceeding the prices paid by the health insurance companies by up to 30% according to some calculations (Hlavačka *et al.* 2004).

[37] Out-of-pocket expenditures represented on average 92% of private spending in the ECA countries in 1998, with a similar figure across groups of FFS and PBP adopters. In 2004, those figures were still very high (in excess of 86%). The data were obtained from the WHO's *Health for All* database; there is no available data prior to 1998. With only a few exceptions (e.g. Slovenia), voluntary health insurance does not play an important role in the countries of the ECA region.

charges and co-payments for hospital care—sometimes reaching 25% for selected inpatient services, e.g. surgeries—were introduced alongside (or closely following) switches from budgets to either FFS or PBP, with such extra funds being channeled directly from patients to providers.[38] For the countries in our sample, such concerns tend to be aggravated by the extra private costs arising from the continued and widespread prevalence of informal payments perceived in many of the ECA health systems (Lewis 2002). But there is also evidence that out-of-pocket spending on drugs increased in some countries following the transition from the old Semashko system (Habicht *et al.* 2006); whether this was contemporaneous with let alone a consequence of changes to hospital payment methods is unclear, however. Whatever the explanation of the impact of hospital payment reform on private spending, the results in our paper raise concerns about the potentially pervasive effects that the joint implementation of co-payments and user charges on the one hand, and new payment methods such as FFS on the other hand, may have on access to health care and the incidence of catastrophic health spending (Wagstaff and van Doorslaer 2003).

In the above scenario, the lack of FFS impacts on amenable mortality suggests that most of the additional health spending and the additional hospital care caused by a switch from budgets to FFS did not bring any perceptible benefits to patients in terms of extra years of life. A negative interpretation of our results would then be that any extra (public and private) expenditure associated with a typical hospital admission simply gives providers additional rents and that the additional admissions caused by a shift to FFS are generally unnecessary ones where the patient could have been treated perfectly well by a lower-level provider. A more positive interpretation would be that

[38] This was the case, among other countries, in Georgia, Kyrgyz Republic, Romania and the Slovak Republic.

the extra admissions and any increased costliness of admissions resulted in improvements in people's quality of life, which we do not capture through our mortality measures.

What about the results for PBP methods? As discussed in Section 3, a hospital paid per case can increase its profits by treating more patients; by cutting on inputs per case treated; and/or selecting the more profitable cases (if patient selection is possible). Our results indicate that PBP-paid hospitals in the adopter ECA countries did not generally seek to profit from treating larger numbers of patients, but did cut inpatient days by reducing an important input, namely length of stay. Instead of reductions in the normally excessive beds supply inherited from the communist era, any efficiency gains from the improved use of resources under PBP seem to have been achieved by a reduction in the bed-occupancy rate. This may reflect political constraints: individual hospitals may find it hard to close wards, and ministries of health and regional governments—who are still operating most (or all) hospitals in the majority of ECA countries, including the PBP adopters—may find it hard to close hospitals. In this context, cutting the bed-occupancy rate seems easier politically. Our finding that the introduction of PBP leads to a rise in health expenditures but no increase in admissions is consistent with an increased cost per admission, which is consistent with previous research (e.g., Ellis and McGuire 1986; Dafny 2005). The evidence also points to a similar relative effect of PBP methods on public and private spending, the latter (as discussed for the case of FFS) due either to the introduction of co-payments and user charges for inpatient care alongside provider payment reforms, or to people substituting away from hospital care to other providers. Either way there is a concern about reduced access to care and higher risk of catastrophic health spending.[39]

Given the above, our (admittedly rather weak) findings regarding the effects of PBP on amenable mortality can be explained by a couple of plausible causal chains. The negative effect on ALOS might lead us to worry about unduly early discharges and higher mortality rates among hospital patients. Insofar as our results reflect an increased cost per admission following a switch to PBP, the implication is that this increased intensity of care more than offsets any damaging effect on mortality of a shorter length of stay. But this begs the question of why the extra resources associated with the switch to FFS did not also lead to lower amenable mortality rates. One explanation would be that the introduction of PBP encouraged providers to focus on appropriate and effective medical care, while the introduction of FFS simply encouraged hospitals to supply extra services irrespective of their effectiveness and appropriateness. In some countries, treatment protocols were introduced when case-based or DRG systems were introduced; these took the form of clinical pathways and guidelines in countries such as Bulgaria and Slovenia, and it is possible that these measures resulted in better quality of care and improved health status for hospital inpatients.

But our findings are also consistent with a less positive interpretation: in addition to any genuine health benefits induced by the development of treatment protocols, PBP introduction may have led to *apparent* improvements in amenable mortality as a consequence of different forms of patient selection. Patient selection by

[39] As a couple of examples among the group of PBP adopter countries, it has been estimated that around 86% of inpatients pay for hospital care in the Kyrgyz Republic, and that a single case of hospitalization can consume a full month's earnings of a poor family through out-of-pocket payments in Georgia, effectively deterring access to care. See the corresponding country reports in the *HiT* series.

hospitals may not only have taken the "classic" form of a preference for patients with the more profitable diagnoses, but also the subtler form of hospitals artificially upcoding patients to more lucrative conditions, the so-called "DRG creep" (cf. e.g. Ellis and McGuire 1986).[40] If a group of hospitals in a given country attempted to raise revenues after PBP adoption by selecting more profitable patients—referring the less profitable ones to another group of providers—and misclassifying patients to more lucrative diagnoses, no effects of PBP introduction (relative to budgets) should be observed on the overall number of admissions (assuming most patients are eventually admitted somewhere), but the aggregate cost per admission and health spending would rise, results that are consistent with the empirical findings in this paper.[41] However, just as the absence of PBP effects on aggregate admissions and higher cost per admission may be logical consequences of patient selection by groups of hospitals within PBP countries, the likely existence of "DRG creep" behavior by hospitals may also result in apparent mortality improvements for some specific conditions. Based on the findings by Cutler (1995) for a different context, if the marginal per case rates paid to hospitals corresponding to ischemic heart and cerebrovascular diseases tended to increase after PBP adoption relative to the marginal rates for other conditions, profit-seeking hospitals may have started coding as heart and cerebrovascular cases some less serious conditions that, under the previous budget system, were not coded as such. It would be plausible, then, to observe the described upcoding process leading to a less severely ill pool of patients for these two disease categories in PBP-paid hospitals than in budget-paid hospitals,

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[40] Indeed, there is anecdotal evidence on the existence of "DRG creep" for a number of ECA countries and preliminary statistical evidence on its presence at least for the Hungarian health system (Belli 2003; Gaál 2004). Gaál (2004)'s conclusion for Hungary is based on the fact that "increases in the case mix index were not coupled with an increase in hospital mortality" (p.77).

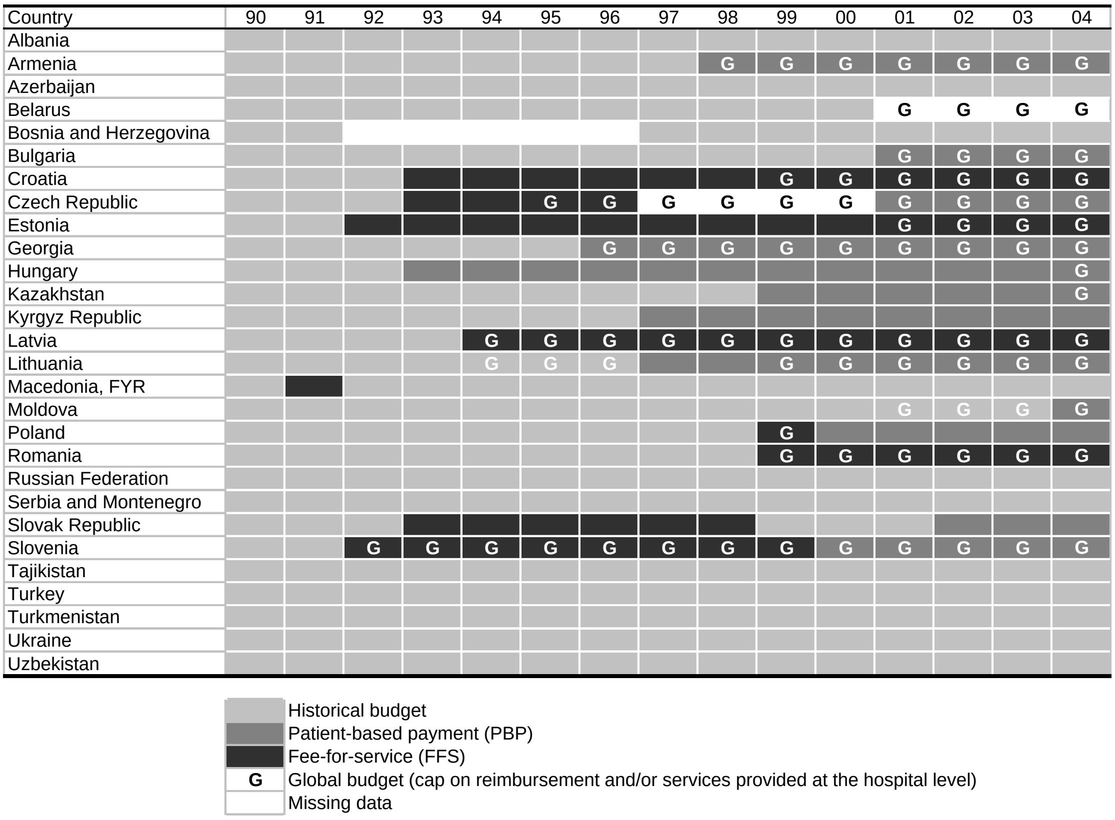
[41] This is in accordance also with the findings of Dafny (2005) in the context of the implementation of prospective payment for Medicare admissions in the United States.

resulting in lower corresponding mortality rates as found in this paper. The presence of “DRG creep” means that the observed mortality reductions may actually reflect upcoding practices induced by the new relative prices rather than true improvements in population health.[42]

On balance, our results suggest that PBP dominates FFS in that while both increase spending by similar percentages, only PBP appears to have any effect on amenable mortality. However, FFS does appear to raise inpatient days while PBP does not, and it is possible that these additional days of hospital care translate into improvements in health outcomes, albeit ones that do not get reflected in lower rates of amenable mortality. This suggests exploring a mix of two or more provider payment mechanisms, including new modalities of global budgets such as those piloted in Croatia, Czech Republic and the Russian region of Kemerovo (cf. Belli 2003).

[42] Unfortunately, data on relative changes of reimbursement rates across categories of diagnoses are not readily available for the ECA countries.

Figure 1: Predominant hospital payment methods in the ECA region, 1990-2004



Source: WHO *HiT* series (http://www.euro.who.int/observatory/Hits/TopPage), World Bank staff and country reports.

Table 1: Hypothesized effects of shifting from line-item budgets, and main findings

	Fee-for-service (FFS)		Patient-based payment (PBP)	
	Hypothesized effect	*Estimated effect*	Hypothesized effect	*Estimated effect*
No. admissions	Positive.	*A significant increase of 2-7.5%.*	Positive (larger than FFS effect).	*No effect.*
Average length of stay	Uncertain.	*No effect.*	Negative.	*A significant reduction of 3.5-4.5%.*
No. beds	Uncertain.	*No effect.*	Uncertain.	*No effect.*
Bed-occupancy rate	Positive, assuming hospitals can alter their bed stock.	*A significant increase (mostly after one year) of 8%.*	Positive, assuming hospitals can alter their bed stock.	*A contemporaneous negative effect offset by a lagged positive effect.*
Cost per admission	Uncertain but probably positive.	*Cannot test.*	Negative.	*Cannot test.*
Quality of care	Uncertain but possibly positive.	*Cannot test.*	Uncertain but possibly negative.	*Cannot test.*
Total hospital costs	Uncertain but probably positive.	*Cannot test.*	Uncertain.	*Cannot test.*
Total health expenditure	Positive.	*Significant increase of 18-19%, with similar percentage increases in public and private spending.*	Uncertain.	*Significant increase of 11-21%, with similar percentage increases in public and private spending.*
Amenable mortality	Uncertain but probably negative.	*No effects.*	Uncertain.	*Significant negative effects for some conditions in some model specifications.*

Table 2: Health sector outcome variables: descriptive statistics

	Full sample			FFS = 1			PBP = 1			Historical budget = 1		
Dependent variable	Mean	S.D.	Obs	Mean	S.D.	Obs	Mean	S.D.	Obs	Mean	S.D.	Obs
Inpatient admissions	16.01	5.89	389	18.65	3.28	62	16.29	6.59	71	15.29	6.00	256
Hosp discharges - circulatory	1851.99	1046.65	346	2436.78	698.97	60	2232.06	1420.10	67	1575.50	880.67	219
Hosp discharges - cerebrovascular	328.22	230.40	342	458.50	132.78	60	420.32	310.30	66	263.88	196.85	216
Hosp discharges - respiratory	2070.39	998.60	343	1910.45	656.14	60	1761.68	767.77	67	2210.57	1109.31	216
Hosp discharges - digestive	1599.84	609.19	346	1803.01	392.80	60	1493.78	630.65	67	1576.63	640.14	219
Hosp discharges - musculoskeletal	756.42	493.11	346	1014.15	315.49	60	872.02	676.23	67	650.44	430.99	219
Length of stay	12.77	3.07	390	11.55	2.13	62	10.73	2.01	71	13.62	3.14	257
Hospital beds	8.08	2.91	339	7.43	1.71	51	7.08	1.67	53	8.45	3.24	235
Bed occupancy rate	72.84	14.88	274	77.40	7.52	44	73.97	17.02	60	71.26	15.30	170
Health expenditures - Total	388.24	283.91	317	645.64	231.34	55	552.10	411.95	59	270.88	152.77	203
Health expenditures - Public	287.15	243.17	317	509.85	220.95	55	391.57	353.96	59	196.46	136.11	203
Health expenditures - Private	101.09	72.38	317	135.78	68.46	55	160.53	84.73	59	74.42	52.97	203
SDR ischemic heart disease	302.48	130.11	354	259.33	93.83	62	281.73	106.63	65	320.21	141.05	227
SDR diabetes	15.08	8.62	354	13.26	6.57	62	17.06	12.10	65	15.02	7.80	227
SDR cerebrovascular diseases	175.99	53.64	354	168.27	46.75	62	164.96	56.49	65	181.25	54.05	227
SDR female breast cancer	21.52	6.72	354	26.39	3.13	62	24.63	5.90	65	19.30	6.62	227
SDR appendicitis	0.30	0.18	341	0.22	0.14	62	0.22	0.11	63	0.35	0.19	216
SDR hernia & intestinal	2.24	0.75	344	2.28	0.57	62	2.26	0.61	64	2.22	0.83	218
SDR adverse effects	0.20	0.33	181	0.09	0.08	50	0.08	0.08	42	0.31	0.44	89

Note: Mean, standard deviation (S.D.) and number of observations (Obs) for the full sample and for the sub-samples of country-year combinations with fee-for-service methods (FFS = 1), patient-based payment (PBP = 1) and budgets (Historical budget = 1) as the predominant hospital payment method.

Table 3: Tests of the parallel trend assumption and reverse causality

	Tests of the parallel trend assumption					Tests of reverse causality		
	Random trend model		Differential trend model			Lead payment dummies test on the preferred model		
	Generalized Hausman test on eqn (8)		Non-linear restriction test on eqn (12)					
Dependent variable	chi-square	p-value	*F*	p-value	Preferred model	$FFS_{i,t+1}$	$PBP_{i,t+1}$	p-value (joint)
Inpatient admissions	0.14	0.934	0.30	0.746	DID	0.10	0.32	0.625
Hosp discharges - circulatory	3.68	0.159	2.20	0.132	DID	0.74	61.01	0.366
Hosp discharges - cerebrovas	5.98**	0.050	0.19	0.827	RT	-1.47	11.40	0.426
Hosp discharges - respiratory	4.29	0.117	0.05	0.948	DID	73.98	79.77	0.165
Hosp discharges - digestive	4.94*	0.084	0.07	0.933	RT	41.67	78.58	0.155
Hosp discharges - musculo	1.00	0.608	0.37	0.696	DID	21.31	43.68	0.104
Length of stay	0.13	0.935	0.26	0.776	DID	0.09	-0.09	0.478
Hospital beds	0.99	0.611	3.37**	0.050	DT	0.03	-0.07	0.858
Bed occupancy rate	4.82*	0.090	1.31	0.290	RT	1.51	0.90	0.167
Health expenditures - Total	0.13	0.938	0.16	0.852	DID	38.86	-8.56	0.155
Health expenditures - Public	3.81	0.149	0.09	0.913	DID	28.18	-1.50	0.224
Health expenditures - Private	1.76	0.415	0.02	0.978	DID	10.68	-7.05	0.393
SDR ischemic heart disease	6.41**	0.040	0.42	0.659	RT	-2.80	-4.05	0.473
SDR diabetes	4.98*	0.083	0.32	0.730	RT	0.96*	0.59*	0.063
SDR cerebrovascular diseases	0.82	0.662	1.60	0.223	DID	-8.99	-1.94	0.211
SDR female breast cancer	2.46	0.292	0.00	1.000	DID	0.04	-0.10	0.972
SDR appendicitis	2.78	0.249	0.24	0.790	DID	-0.09	0.04	0.254
SDR hernia & intestinal	2.19	0.334	1.19	0.323	DID	-0.36	-0.19	0.141
SDR adverse effects	1.60	0.450	1.70	0.215	DID	0.06	0.08	0.516

Notes: The symbols * and ** indicate rejection of the null hypothesis of the corresponding parallel trend test or reverse causality test at the 10% and 5% levels, respectively (p-values from two-sided *t*-tests with cluster-robust standard errors). The last column of the parallel trend tests shows the preferred model—difference-in-differences (DID), random trend (RT) or differential trend (DT)—implied by the test results for the corresponding dependent variable. Results of the reverse causality tests refer to the individual coefficients of the lead fee-for-service (FFS) and patient-based (PBP) payment methods dummies (respectively) in the preferred model, and p-values from two-sided *t*-tests (with cluster-robust standard errors) for the null hypothesis of joint insignificance of these two variables.

Table 4: Estimated impacts of hospital payment methods on health sector outcomes

Dependent variable	Preferred model	Preferred model estimates					
		FFS	p-value	Impact	PBP	p-value	Impact
Inpatient admissions	DID	0.35*	0.093	2.1%	0.04	0.827	0.3%
Hosp discharges - circulatory	DID	156.01**	0.009	8.0%	84.64	0.494	4.4%
Hosp discharges - cerebrovas	RT	16.61	0.244	4.8%	-12.79	0.302	-3.7%
Hosp discharges - respiratory	DID	169.51**	0.004	8.2%	59.15	0.301	2.9%
Hosp discharges - digestive	RT	111.2**	0.026	6.8%	17.11	0.608	1.0%
Hosp discharges - musculo	DID	50.07*	0.079	6.3%	-21.52	0.320	-2.7%
Length of stay	DID	-0.31	0.347	-2.5%	-0.44**	0.033	-3.5%
Hospital beds	DT	0.09	0.749	1.1%	-0.12	0.575	-1.5%
Bed occupancy rate	RT	0.50	0.819	0.7%	-3.79**	0.044	-5.2%
Health expenditures - Total	DID	81.39**	0.007	19.9%	46.15*	0.057	11.3%
Health expenditures - Public	DID	51.99*	0.051	17.1%	21.61	0.450	7.1%
Health expenditures - Private	DID	29.39**	0.034	27.8%	24.54*	0.064	23.2%
SDR ischemic heart disease	RT	-2.89	0.679	-0.9%	-12.66*	0.099	-4.1%
SDR diabetes	RT	-0.51	0.708	-3.4%	-1.12	0.215	-7.6%
SDR cerebrovascular diseases	DID	-1.95	0.582	-1.1%	-8.14**	0.035	-4.6%
SDR female breast cancer	DID	0.35	0.567	1.6%	-0.45	0.390	-2.1%
SDR appendicitis	DID	0.00	0.974	-0.8%	-0.05	0.170	-17.7%
SDR hernia & intestinal	DID	0.03	0.823	1.5%	0.11	0.202	4.9%
SDR adverse effects	DID	0.01	0.857	5.8%	-0.04	0.570	-19.5%

Notes: Results refer to the coefficients of the fee-for-service (FFS) and patient-based (PBP) payment methods dummies estimated in the preferred model for each outcome—difference-in-differences (DID), random trend (RT) or differential trend (DT) model. P-values from two-sided *t*-tests with cluster-robust standard errors. FFS and PBP percentage impacts implied by the corresponding coefficients are calculated over the mean outcome variable in the corresponding estimating sub-sample. The symbols * and ** denote statistical significance at the 10% and 5% levels, respectively.

Table 5: Alternative classifications of hospital payment methods in the ECA region

Country	Alternative classification of hospital payment methods	Comments
Bulgaria	B=1 1990-2003 PBP=1 2004	Per case payment introduced in 2001 but would reach 50% of social health insurance reimbursements only in 2004.
Croatia	B=1 1990-92 FFS=1 1993-2001 PBP=1 2002 onwards	In 2002, introduction of a parallel DRG-based payment system for costly interventions.
Kazakhstan	B=1 1990-94 PBP=1 1995 onwards	Per case payment rolled-out only in 1999 but piloted since 1995.
Kyrgyz Republic	B=1 1990-2000 PBP=1 2001 onwards	It was only under the single payer system started in 2001 that PBP was rolled-out in the whole country.
Latvia	B=1 1990-93 FFS=1 1994-97 PBP=1 1998 onwards	DRGs introduced in 1998 to be used along with FFS, representing about 20% of the total number of hospitalizations.
Lithuania	B=1 1990-93 PBP=1 1994 onwards	Since 1994, funding of all republican hospitals (40% of beds) by cost per case; unified PBP system from 1997 onwards.
Poland	B=1 1990-98 FFS=1 1999-2002 PBP=1 2003 onwards	Sickness funds introduced their own systems of DRGs in the year 2000, but uniform DRG classification took place only in 2003.
Russian Federation	B=1 1990-92 PBP=1 1993 onwards	New payment methods introduced since 1993 by social health insurance agencies—mostly case-based payment variants—account for around one-third of hospital revenues.
Turkmenistan	B=1 1990-95 PBP=1 1996 onwards	Voluntary health insurers started to pay hospitals per case in 1996, accounting for around 30% of the average hospital funding.

Notes: Hospital payment methods are historical (line-item) budgets (B); fee-for-service (FFS) and patient-based payment (PBP).

Table 6: Robustness of impact estimates to alternative classifications and specification

Panel A: Models with alternative payment methods classifications

Dependent variable	Preferred model	FFS	Impact	PBP	Impact
Inpatient admissions	DID	0.42**	2.6%	0.00	0.0%
Hosp discharges - circulatory	DID	163.84**	8.4%	112.09	5.8%
Hosp discharges - cerebrovas	DID	23.07**	6.6%	-1.99	-0.6%
Hosp discharges - respiratory	RT	146.76**	7.1%	50.07	2.4%
Hosp discharges - digestive	DID	105.07**	6.4%	7.15	0.4%
Hosp discharges - musculo	DID	42.21	5.3%	-8.11	-1.0%
Length of stay	DT	-0.06	-0.5%	-0.26	-2.0%
Hospital beds	DID	-0.03	-0.4%	-0.34	-4.2%
Bed occupancy rate	DT	-0.22	-0.3%	-3.33**	-4.6%
Health expenditures - Total	DID	75.45**	18.4%	43.30*	10.6%
Health expenditures - Public	DID	50.60**	16.7%	23.17	7.6%
Health expenditures - Private	DID	24.85**	23.5%	20.13	19.1%
SDR ischemic heart disease	DID	-4.47	-1.4%	-4.56	-1.5%
SDR diabetes	RT	-0.72	-4.9%	-0.91	-6.1%
SDR cerebrovascular diseases	DID	-2.40	-1.4%	-6.87	-3.9%
SDR female breast cancer	DID	0.52	2.4%	-0.16	-0.7%
SDR appendicitis	DID	-0.01	-2.3%	0.02	5.7%
SDR hernia & intestinal	DID	-0.04	-1.8%	0.03	1.6%
SDR adverse effects	DID	0.04	20.6%	0.02	7.3%

Panel B: Models with lagged payment methods dummies added

						Linear combination: two FFS variables		Linear combination: two PBP variables	
Dependent variable	Preferred model	FFS	Lagged FFS	PBP	Lagged PBP	Coef	Impact	Coef	Impact
Inpatient admissions	DID	0.48**	0.73**	0.00	0.50	1.21**	7.5%	0.50	3.1%
Hosp discharges - circulatory	DID	153.62**	89.49	65.65	0.68	243.11**	12.5%	66.33	3.4%
Hosp discharges - cerebrovas	DID	19.20	6.82	-12.66	14.31	26.02	7.4%	1.65	0.5%
Hosp discharges - respiratory	DID	160.39**	169.83**	64.39	164.99*	330.22**	16.3%	229.38**	11.3%
Hosp discharges - digestive	RT	102.68**	110.68**	17.37	56.01*	213.36**	13.1%	73.38	4.5%
Hosp discharges - musculo	DID	47.76*	63.64**	-24.92	25.53	111.40**	14.1%	0.62	0.1%
Length of stay	DID	-0.32	-0.06	-0.42**	-0.14	-0.38	-3.1%	-0.56**	-4.5%
Hospital beds	DID	0.05	0.01	-0.04	0.13	0.05	0.7%	0.09	1.1%
Bed occupancy rate	DID	2.02	3.68**	-2.79	2.51*	5.70**	7.9%	-0.28	-0.4%
Health expenditures - Total	DID	73.00**	2.17	55.69**	32.06**	75.17*	18.4%	87.75**	21.4%
Health expenditures - Public	DID	49.58*	6.22	36.03	31.00**	55.80*	18.4%	67.03**	22.1%
Health expenditures - Private	DID	23.42*	-4.04	19.66*	1.06	19.37	18.2%	20.72	19.5%
SDR ischemic heart disease	DID	-4.61	0.56	-12.75**	-4.89	-4.05	-1.3%	-17.64**	-5.7%
SDR diabetes	DID	-0.83	-1.26	-1.26	-0.39	-2.09*	-13.9%	-1.65*	-11.0%
SDR cerebrovascular diseases	DID	-2.39	-0.39	-8.30**	3.62	-2.78	-1.6%	-4.68	-2.6%
SDR female breast cancer	DID	0.39	0.00	-0.54	0.16	0.39	1.8%	-0.38	-1.7%
SDR appendicitis	DID	0.00	-0.03	-0.03	-0.07*	-0.03	-10.2%	-0.10	-34.2%
SDR hernia & intestinal	RT	0.02	0.06	0.01	-0.07	0.09	3.9%	-0.06	-2.8%
SDR adverse effects	DID	-0.01	-0.06	-0.15	-0.03	-0.07	-32.6%	-0.17	-79.4%

Notes: Results in each panel refer to the coefficients of the fee-for-service (FFS) and patient-based (PBP) payment methods dummies estimated in the preferred model for each outcome—difference-in-differences (DID), random trend (RT) or differential trend (DT) model, implied by the corresponding tests of the parallel trend assumption (not shown). In Panel B, the coefficients of the first lags of the payment methods dummies and the linear combinations of FFS (level and lag) and PBP (level and lag) are also reported. The symbols * and ** denote statistical significance at the 10% and 5% levels, respectively, according to p-values from two-sided *t*-tests with cluster-robust standard errors (not shown). FFS and PBP percentage impacts implied by the corresponding coefficients are calculated over the mean outcome variable in the corresponding estimating sub-sample.

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